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Final Report

A Conference on "Diagnostic Monitoring of Skill and Knowledge Acquisition"

Norman Frederiksen

Educational Testing Service

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Frederiksen, Norman

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A book entitled "Diagnostic Monitoring of Skill and Knowledge Acquisition" edited by Norman Frederiksen, Robert Glaser, Alan Lesgold, and Michael Shafto will be published.

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Much of the research in cognitive science has been concerned with identifying and describing the information-processing skills and knowledge that are involved in problem solving and in acquiring an understanding of an area of expertise. In applying this knowledge to the management of instruction, it would seem desirable to devise ways of monitoring change in cognitive skills by collecting information about levels of development of automatic processing of basic procedures, the nature of the students' knowledge structures, and the adequacy of his/her problem-solving control strategies. Conventional psychometric methods fail to yield such diagnostic information. The purpose of this project was to call attention to the need for diagnostic monitoring of skill and knowledge acquisition during the instructional process and to provide some examples of methods for obtaining such information. A conference was organized to discuss the implications of cognitive science for the assessment of learning, with the expectation that the presentations would be revised and extended for publication in book form. Twenty-six authors and coauthors contributed 15

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chapters, and 4 discussants have so far contributed commentaries to sets of chapters (a fifth commentary will probably be added). A manuscript containing an introduction, the 15 chapters, and four commentaries has been sent to the publisher for publication under the title "Diagnostic Monitoring of Skill and Knowledge Acquisition." The publication date is expected to be sometime in the fall of 1989.

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The purpose of this project was to encourage cognitive scientists to consider the implications of their research for assessment as well as for instruction. Conventional methods of assessment are not adequate for two reasons: (a) since the score on a conventional test is based on the number of correct answers to a set of items that vary widely in difficulty and in content, it is not possible to obtain such qualitative information as a student's problem-solving procedures or the nature of his/her mental model of a domain; and (b) the items of conventional tests tend to emphasize factual and algorithmic knowledge rather than understanding.

It was proposed that a conference be held at which leading cognitive scientists would address the question of how their work could be adapted to assessing various aspects of performance during learning, such as level of automatization of basic procedures, incomplete or erroneous knowledge structures, and inadequate regulatory control strategies. The conference was thus intended to call attention to the need for diagnostic monitoring of skill and knowledge acquisition during the instructional process and to provide examples of assessment methods that grow out of cognitive research.

When the project was funded in the fall of 1985, Michael Shafto was designated Scientific Officer, and arrangements were made for Robert Glaser and Alan Lesgold to serve as advisors to the project. Our first task was to decide on who should be invited to participate in the conference. After a meeting at LRDC and after allowing several weeks for consideration, a selection was made of those who should be invited to present papers or serve as discussants. Almost all of those invited agreed to participate.

Since the research of most of the presenters was concerned with learning rather than assessment, we felt that a special effort was needed to orient them toward applications of their work toward diagnosis of sources of error and misconceptions, and thus to develop a shared point of view with regard to the purpose of the conference. Therefore a planning meeting was held at LRDC in November 1985 at which the theme of the conference was discussed and each participant was given an opportunity to reflect and report on the implications of his or her research for assessment. The goal was to achieve a well-integrated set of presentations and eventually chapters for publication in book form.

The conference was held at the Henry Chauncey Conference Center at ETS on July 17, 18, and 19, 1986. A copy of the program is attached. The conference was attended by approximately 65 people, including not only cognitive scientists but also educators, educational researchers, and psychometricians.

At the time of the conference, a contract for publication of the proceedings by Lawrence Erlbaum Associates was agreed to. The four editors are N. Frederiksen, R. Glaser, A. Lesgold, and M. G. Shafto. The MS was sent to the publisher in late November, 1988. Copies of the title page and the table of contents are appended. The MS is complete except for one commentary, which may yet arrive in time to be included in the volume. If all of the corrected proofs are returned to the publisher promptly, the publication date should be in the late fall of 1989.

PROGRAM

Conference on
Diagnostic Monitoring of Skill and Knowledge Acquisition

Thursday, July 17

9:00	Gregory Anrig	Opening Remarks
	C. Victor Bunderson, Chairman	
9:10	John R. Anderson	Analysis of Student Performance with the LISP Tutor
9:50		Discussion
10:00	John Frederiksen and Barbara White	Intelligent Tutors as Intelligent Testers
10:40		Discussion
10:50		BREAK
11:05	David Kieras	The Role of Cognitive Simulation Models in Advanced Training and Assessment Technology
11:45		Discussion
11:55	Allan Collins (discussant)	
12:20		General discussion
12:30		LUNCH
	William C. Ward Chairman	
1:30	James Reggia	The Role of Diagnostic Reasoning Models in Assessment and Adaptive Instruction
2:10		Discussion
2:20	Pat Langley, Stellan Ohlsson, & James Wogulis	Rules and Principles in Automated Cognitive Diagnosis
3:00		Discussion
3:10		BREAK
3:25	Stellan Ohlsson	Intensive vs. Extensive Cognitive Diagnosis: A Case Study and Its Implications
4:05		Discussion
4:15	James D. Hollan (discussant)	
4:40		General Discussion
5:00		ADJOURN

Friday, July 18

Roy O. Freedle, Chairman

9:00	Harry S. Pople and Cynthia S. Gadd	Evidence from Internal Medicine Teaching Rounds of the Multiple Roles of Diagnosis in the Transmission and Testing of Medical Expertise
9:40		Discussion
9:50	Ann Brown and Joseph C. Campione	Guided Learning and Transfer: Implications for Assessment
10:30		Discussion
10:40		BREAK
11:00	Carl Frederiksen	Evaluating Prior Knowledge and Its Use in Comprehension, Knowledge Integration, Production, and Problem Solving
11:40		Discussion
11:50	George A. Miller (discussant)	
12:15		General discussion
12:35		LUNCH

Henry I. Braun, Chairman

1:30	Sandra P. Marshall	Selecting Good Diagnostic Items
2:10		Discussion
2:20	Susan Embretson	Psychometric Methods for Diagnosing Processing at Different Performance Levels
3:00		Discussion
3:10		BREAK
3:30	Kikumi Tatsuoka	Toward an Integration of Item-Response Theory and Cognitive Error Diagnoses
4:10		Discussion
4:20	Robert Linn (discussant)	
4:45		General discussion
5:00		ADJOURN

Saturday, July 19

Walter Emmerich, Chairman

9:00	Robert S. Siegler	Diagnostic Monitoring of Strategy Choice Procedures
9:40		Discussion
9:50	Mary S. Riley	Diagnosing Levels of Competence in Knowledge-Rich Domains
10:30		Discussion
10:40		BREAK
11:00	Sherrie Gott (discussant)	
11:25		General discussion
11:45		LUNCH

Garlie A. Forehand, Chairman

12:45	Walter Schneider and Wesley Regian	Assessment Procedures for Predicting and Optimizing Skill Acquisition in Extended Training
1:25		Discussion
1:35	Alan Lesgold	Cognitive Task Analysis Approaches to Testing
2:15		Discussion
2:25		BREAK
2:45	Judith Orasanu (discussant)	
3:10		General discussion
3:30	Robert Glaser	The Final Word
4:00		ADJOURN

DIAGNOSTIC MONITORING OF SKILL AND KNOWLEDGE ACQUISITION

Edited by

NORMAN FREDERIKSEN
Educational Testing Service

ROBERT GLASER
University of Pittsburgh

ALAN LESGOLD
University of Pittsburgh

MICHAEL G. SHAFTO
NASA - Ames Research Center

CONTENTS

Dr. Robert Ahlers
Code N711
Human Factors Laboratory
NAVTRAEQUIPCEN
Orlando, FL 32813

Dr. Earl A. Alluisi
HQ, AFHRL (AFSC)
Brooks AFB, TX 78235

Technical Director, ARI
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. John J. Collins
Director, Field Research
Office, Orlando
NPRDC Liaison Officer
NTSC Orlando, FL 32813

Dr. Stanley Collyer
Office of Naval Technology
Code 222
800 N. Quincy Street
Arlington, VA 22217-5000

Dr. R. K. Dismukes
Associate Director for Life Sciences
AFOSR
Bolling AFB
Washington, DC 20332

Dr. Sherrie Gott
AFHRL/MODJ
Brooks AFB, TX 78235

Janice Hart
Office of the Chief
of Naval Operations
OP-11HD
Department of the Navy
Washington, D.C. 20350-2000

Dr. Joe McLachlan
Navy Personnel R&D Center
San Diego, CA 92152

Dr. James McMichael
Assistant for MPT Research,
Development, and Studies
NAVOP 01B7
Washington, DC 20370

Dr. William Montague
NPRDC Code 13
San Diego, CA 92152

Office of Naval Research,
Code 1142PT
800 N. Quincy Street
Arlington, VA 22217-5000
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Office of Naval Research,
Code 125
800 N. Quincy Street
Arlington, VA 22217-5000

Psychologist
Office of Naval Research
Branch Office, London
Box 39
FPO New York, NY 09510

Special Assistant for Marine
Corps Matters,
ONR Code 00MC
800 N. Quincy St.
Arlington, VA 22217-5000

Psychologist
Office of Naval Research
Liaison Office, Far East
APO San Francisco, CA 96503

Dr. Judith Orasanu
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. Joseph Psotka
ATTN: PERI-1C
Army Research Institute
5001 Eisenhower Ave.
Alexandria, VA 22333

Dr. John Tangney
AFOSR/NL
Bolling AFB, DC 20332

Dr. James Tweeddale
Technical Director
Navy Personnel R&D Center
San Diego, CA 92152

Dr. Joseph L. Young
Memory & Cognitive
Processes
National Science Foundation
Washington, DC 20550

Dr. Steven Zornetzer
Office of Naval Research
Code 1140
800 N. Quincy St.
Arlington, VA 22217-5000

Dr. Michael G. Shafto
NASA-Ames Research Center
Aerospace Human Factors Research Division
Mail Stop 239-1
Moffett Field, CA 94035